

Answer the following questions

Total Marks 50

أجب عن الأسئلة الآتية:

(N=14, C=12, H=1 and O=16)

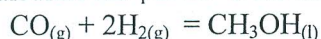
**Question No. (1) (10 Marks)**

- Define the concept of partial pressure and derive the relationship between partial pressure, total pressure and mole fraction of a component gas in a gas mixture? (3 Marks)
- List two conditions under which gas can deviate from ideal behaviour and show how you can obtain van der Waals equation of state by the modification of the ideal gas equation of state? (3 Marks)
- Compute the molecular weight of gas mixture and its density at 27 °C and 750 torr, if the mixture of gases has the following composition by weight: CO<sub>2</sub>=0.44%, O<sub>2</sub>=22.4%, N<sub>2</sub>=75.36% H<sub>2</sub>O=1.8%? (4Marks)

**Question No. (2): (10 Marks)**

- State the three laws of thermodynamic? (3 Marks)
- Derive the relationship between C<sub>p</sub> and C<sub>v</sub> for Real gases? (3 Marks)
- Referring to the information in the table at 25°C: (4 Marks)

(1) Calculate ΔS°<sub>r</sub> at 25°C for the reaction:



(2) Calculate ΔS° for CO<sub>(g)</sub> at 25°C.

(3) Discuss the effect of temperature on the spontaneity of the above reaction

Compound	ΔH° <sub>f</sub> kcal/mole	ΔG° <sub>f</sub> kcal/mole	S° cal/mole K
H <sub>2(g)</sub>	0.00	0.00	31.212
CO <sub>(g)</sub>	-26.415	-32.808	-----
CH <sub>3</sub> OH <sub>(l)</sub>	-57.036	-39.747	30.26

**Question No. (3): (10 Marks)**

- What is meant by colligative properties of solutions? (2Marks)
- Ethylene glycol C<sub>2</sub>H<sub>6</sub>O<sub>2</sub> is used as anti-coolant in vehicle's engine cooler (ردياتير السيارات), specially in cold climates. If the temperature reached to -10°C, what weight of ethylene glycol C<sub>2</sub>H<sub>6</sub>O<sub>2</sub> must be added to 100 gm of water to prevent the formation of ice? (consider ΔH<sub>fus</sub> = 1436 cal/mol for water) (4Marks)
- What is the density at 17°C of aqueous solution containing 0.75 gm of sucrose, (C<sub>12</sub>H<sub>22</sub>O<sub>11</sub>), per 2 litre of a solution developed a rise of 26.4 cm at osmotic equilibrium? (4Marks)

**Question No. (4): (10 Marks)**

- Explain the main features of the phase diagram of water? State the phase rule and explain what is meant by its parameters? Apply this rule to interpret the triple point of water on its phase diagram? (4Marks)
- Study the effect of pressure on the melting point of water, starting from a pressure of 1 to 101 atm with an incremental change of 20 atm, where the density of liquid water at 0°C is given as 0.99 gm/cm<sup>3</sup> and that for ice at 0°C is 0.92 gm/cm<sup>3</sup>. (consider ΔH<sub>fus</sub> = 1436 cal/mol for water) (6Marks)

**Question No. (5): (10Marks)**

- Give different Four examples of cathodic reactions and different five examples of anodic reactions? (3Marks)
- Based on the relation between electrode potentials and free energy change, derive the Nernst equation? (2Marks)
- I- Calculate E°<sub>cell</sub> for the reaction:  $\text{Cu}^{++} + \text{Zn} = \text{Cu} + \text{Zn}^{++}$  (5Marks)
- II- What is the potential of the cell containing (Zn<sup>++</sup>/Zn) and (Cu<sup>++</sup>/Cu) couples if the Zn<sup>++</sup> and Cu<sup>++</sup> concentrations are 0.1 and 10<sup>-9</sup> molar, respectively, at a temperature of 25°C.
- III- What is the value of ΔG for the reduction of one mole of Cu<sup>++</sup> ions by Zn at the indicated concentrations of the ions, given in (b), at temperature of 25°C. Also, what is the value of ΔG° for the reaction at 25°C.

If you are taken that:  $\text{Zn}^{++} + 2e = \text{Zn}$  E° = -0.763 v and  $\text{Cu}^{++} + 2e = \text{Cu}$  E° = 0.337 v.

انتهت الأسئلة مع أطيب التمنيات بالتوفيق والنجاح  
أ.د/ أحمد أحمد الصروي